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Our long term research goal has been to develop a rigorous analytic formulation and uniform asymptotic description of pulsed electromagnetic beam-field propagation, reflection, and transmission phenomena in causally dispersive dielectric and conducting media. Emphasis has been placed first on a formulation that has been rigorously obtained from the macroscopic Maxwell's equations with constitutive relations that are appropriate for a homogeneous, isotropic, nonhysteretic, locally linear, temporally dispersive medium, followed by the development and application of the required uniform asymptotic expansion techniques that are necessary to provide a completely continuous description of the space-time evolution of the pulsed beam-field at sufficiently large propagation distances into the dispersive, attenuative medium.

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The Asymptotic Theory of the Reflection and Transmission of a Pulsed Electromagnetic Beam Field at a Planar Interface Separating Two Dispersive Media

AFOSR Grant # F49620-94-1-0430

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Our long-term research goal is to develop a rigorous analytic formulation and, based upon this, a uniform asymptotic description of pulsed electromagnetic beam-field propagation, reflection, and transmission phenomena in causally dispersive dielectric and conducting media. Emphasis has been placed first on a formulation that has been rigorously obtained from the macroscopic Maxwell's equations with constitutive relations that are appropriate for a homogeneous, isotropic, nonhysteretic, locally linear, temporally dispersive medium, followed by the development and application of the required uniform asymptotic expansion techniques that are necessary to provide a completely continuous description of the space-time evolution of the pulsed beam-field at sufficiently large propagation distances from the input plane. A detailed description of the most recent results of this research has been presented in two invited papers by the Principal Investigator. The first paper was an invited paper on "The Angular Spectrum Representation and the Sherman Expansion of Pulsed Electromagnetic Beam-Fields in Lossy, Dispersive Media," at the 1996 USNC/URSI National Radio Science Meeting at the University of Colorado at Boulder. The second paper was an invited paper on "Transient Field Properties of Ultrawideband Pulse Propagation in Complex Dispersive Media," at the 1997 Progress in Electromagnetics Research Symposium (PIERS) in

Cambridge, Massachusetts. A portion of this research resulted in the following publications (reprints attached if available):

K. E. Oughstun and C. M. Balictsis, "Gaussian Pulse Propagation in a Dispersive, Absorbing Dielectric," *Physical Review Letters* **77**, 2210-2213 (1996).

C. M. Balictsis and K. E. Oughstun, "Generalized Asymptotic Description of the Propagated Field Dynamics in Gaussian Pulse Propagation in a Linear, Causally Dispersive Medium," *Physical Review E* **55**, 1910-1921 (1997).

K. E. Oughstun and H. Xiao, "Failure of the Quasimonochromatic Approximation for Ultrashort Pulse Propagation in a Dispersive, Attenuative Medium," *Physical Review Letters* **78**, 642-645 (1997).

K. E. Oughstun, "Asymptotics and Energy Estimates for Electromagnetic Pulses in Dispersive Media: Comments," *Journal of the Optical Society of America A* (accepted).

J. A. Marozas and K. E. Oughstun, "Electromagnetic Pulse Propagation Across a Planar Interface Separating Two Lossy, Dispersive Dielectrics," to be published in Ultra-Wideband, Short-Pulse Electromagnetics 3, (Plenum Press).